

The Chemistry and Distribution of *Cladonia capitellata* (J. D. Hook. & Taylor) Church. Bab. (Lichenes) in Australia

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The taxonomy of the lichen species *Cladonia capitellata* (J. D. Hook. & Taylor) Church. Bab. in Australia is reviewed. Three varieties are recognized, *C. capitellata* var. *capitellata* (usnic and thamnolic acids), *C. capitellata* var. *interhiascens* (Nyl.) Sandst. (usnic acid only) and the new variety *C. capitellata* var. *squamatica* A. W. Archer (usnic and squamatic acids) is described.

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KEY WORDS: *Cladonia capitellata* var. *capitellata*, *Cladonia capitellata* var. *interhiascens*, *Cladonia capitellata* var. *squamatica*, lichens, chemotaxonomy, distribution, Australian lichens.

INTRODUCTION

Cladonia capitellata, a fruticose lichen species, was first described by J. D. Hooker and T. Taylor (1844); the type material was collected by Hooker in New Zealand during the antarctic voyage of H.M.S. *Erebus* and *Terror*. The same taxon was later reported as *Cladina interhiascens* from Campbell Island (Nylander, 1876) and as *Cladonia xanthoclada* from Western Australia (J. Müller, 1882). These two taxa were later reduced in taxonomic status to *C. capitellata* var. *interhiascens* (Nyl.) Sandst. (Sandstede, 1938) and *C. capitellata* subsp. *xanthoclada* (Müll. Arg.) Vainio (Vainio, 1887) respectively. Vainio (1887) reported *C. capitellata* from Brazil but the cited specimen represents an unidentified species containing fumarprotocetraric and usnic acids (T. Ahti, *in litt.* 1984). *C. capitellata* has been reported from South Australia (Filson and Rogers, 1979), Victoria (Leighton, 1867), New South Wales (Vainio, 1887), the Australian Capital Territory (Elix and Streimann, 1982) and Tasmania (Wilson, 1892). A recent description of *C. capitellata* has been given by Filson and Rogers (1979) and Galloway (1985) and photographs of the species may be found in Filson and Rogers (1979: pl.3A) and Martin and Child (1972: pl.4).

CHEMISTRY

The chemistry of *C. capitellata* has been described briefly (Archer, 1985). The species always contains usnic acid, which may be the sole lichen compound present, as in the type materials of *Cladina interhiascens* and *Cladonia xanthoclada*, or the usnic acid may be accompanied by thamnolic acid as in the type material from New Zealand (T. Ahti, *in litt.*), or squamatic acid. Fertile specimens of the last two chemical varieties also contain barbatic acid in the apothecia. This localization of barbatic acid in the apothecia of fertile specimens in many species of the genus *Cladonia* has been reported from the northern hemisphere (Tønsberg, 1980; Ahti, 1983) and has also been found, by the author, in other Australian taxa in the genus *Cladonia*, viz. *C. squamosula* Müll. Arg. and *C. pertricosa* Krempelh. Specimens of *C. capitellata*, and *C. ceneota* (Ach.) Schaer., *C. crispata* (Ach.) Flotow, *C. subfurcata* (Nyl.) Arnold, *C. squamosa* Hoffm. and *C. uncialis* (L.)

Weber in Wigg, from the northern hemisphere, containing squamatic acid also contain a phenolic lichen acid of unknown structure, here tentatively named 'consquamatic acid'. This compound is fluorescent under ultra-violet light like squamatic acid and gives the same colour reactions as squamatic acid with sulphuric acid (Culberson and Kristinsson, 1970) and MBTH (Archer, 1978). It is distinguished from squamatic acid by thin-layer chromatography (Culberson, 1972); in each mobile phase consquamatic acid has an R_f value of 0. The chemistry and morphology of *C. capitellata* place the species in the infra-generic group *Unciales*, in the recently-proposed classification of the genus *Cladonia* (Huovinen and Ahti, 1982).

The infra-specific chemical variations described above are correlated with distributional differences (described below) but not with any apparent morphological differentiation. Hawksworth (1976) proposed that the replacement of one lichen compound by a biogenetically closely related compound, correlated with geographical differences within a taxon, be given taxonomic recognition as a variety. Squamatic and thamnolic acids are considered to be closely related biogenetically (Huovinen and Ahti, 1982) and therefore the chemically differentiated specimens are here formally listed and described as varieties.

VARIETIES OF *Cladonia capitellata*.

Cladonia capitellata (J. D. Hook. & Taylor) Church. Bab. Fl. Novae-Zel. 2:296 (1855).

Cenomyce capitellata J. D. Hook. & Taylor, London J. Bot. 3:652 (1844).

Type collection: New Zealand, *sine loc.* Lectotype: BM.

var. *capitellata*.

Thallus K- yellow, KC+ yellow, Pd- yellow; contains usnic and thamnolic acids and barbatic acid in the apothecia.

Also examined (selected specimens only):

Australia, Western Australia, Mt Chudalup, N. Sammy 15.v.1972 (PERTH NS840926); Frenchmans Bay, Albany, D. Richardson, 18.iv.1980 (PERTH 000841); Porongorups, A. W. Archer 953, 10.x.1980 (NSW).

Tasmania, near Cradle Mountain, R. Filson, 7.i.1965 (MEL 40177); Pine Lake Pass, 22km SSW of Deloraine, G. Bratt, 27.i.1968 (HO 52941); River Crossing, 11km S of Paratah, G. Bratt, 8.v.1971 (HO 40757).

var. *interhiascens* (Nyl.) Sandst.

Fedde's Repert. Beih. 103:36 (1938).

Cladina interhiascens Nyl.

C.R. Séanc. Acad. Sci. Paris 83:87 (1876).

Type collection: New Zealand, Campbell Island, Filhol. Lectotype: H-NYL 37608.

Cladonia capitellata f. *interhiascens* (Nyl.) Vainio

Acta Soc. Fauna Fl. Fenn. 10:466 (1894).

Cladonia xanthoclada Müll. Arg.

Flora, Jena 65:297 (1887).

Type collection: Australia, Western Australia, King George's Sound, Harris L53; Holotype: G.

Cladonia capitellata subsp. *xanthoclada* (Müll. Arg.) Vainio

Acta Soc. Fauna Fl. Fenn. 4:277 (1887).

Thallus K-, KC+ yellow, Pd-; contains usnic acid.

Also examined:

Australia, New South Wales, Pigeon House Range, W. A. Weber, 13.iv.1968 (MEL 33067, NSW); 8km NE of Nerriga, J. A. Elix 3050, 30.iii.1977 (ANUC). Australian Capital Territory, Black Mountain, R. D. Hoogland, 19.x.1961 (NSW L1915). Tasmania, Mt Field West, R. Filson, 20.ii.1968 (MEL 1023708); Lake St Clair, J. A. Elix 5642, 18.i.1979 (ANUC).

Cladonia capitellata var. *squamatica* A. W. Archer, var. nov.

Sicut var. *capitellata* sed acidum squamaticum continens. Thallus K-, KC+ flavescens, Pd-.

The new variety is similar to var. *capitellata* but differs in containing squamatic acid in place of thamnolic acid; fertile podetia also contain barbatic acid in the apothecia. Thallus K-, KC+ yellow, Pd-.

Type collection: Australia, New South Wales, Tinderry Range, 60km N of Cooma, alt. ca 1100m, A. W. Archer 1222A, 15.xi.1981. Holotype: NSW; isotype: MEL 1047760.

Also examined (selected specimens only):

Australia, Western Australia, Mt Chudalup, N. Sammy, 15.v.1972 (PERTH NS 840927); 2km W of Shannon River, 21.vii.1953, (PERTH 000529); Porongorups, D. Richardson, 20.iv.1980 (PERTH 000913).

South Australia, 14km SE of Mt Burr Township, J. B. Wilson 549, 7.ix.1966 (AD 97413229).

Victoria, Grampians, Black Range, L. D. Williams 1449, 2.ix.1962 (AD 9204); Byaduk Caves, Byaduk, A. C. Beaglehole 3943, 2.i.1956 (MEL 33181); Nicholson Creek near Maffra, F. R. M. Wilson, —.iii.1889 (NSW L3880); Mt Feathertop, A. F. Wilson, —.iii.1888 (NSW L3883); Beechworth, Ovens River, F. von Mueller, 1881, (G).

Australian Capital Territory, Black Mountain, J. Taylor 18, 22.vii.1975 (CBG 8004120); Blue Range, 25km SW of Canberra, A. W. Archer 1121, 1.ix.1981 (NSW).

New South Wales, Goulburn, E. Cheel, 18.iv.1908 (NSW L3730); Mt Dowe, A. W. Archer 1270, 12.x.1981 (NSW); Five Dock, E. Cheel, 16.ix.1911 (NSW).

Tasmania, Seal Island, Bass Strait, J. S. Whinsay, 16.xii.1973 (MEL 1012788); Mt Barrow, A. W. Archer 893, 24.ii.1980 (NSW); Cracraft Range, G. Bratt 2682, 17.ix.1965 (HO 53035).

TABLE 1

Number of collections of *Cladonia capitellata* varieties in Australian States

	WA	NT	SA	Q	NSW ^a	Vic.	Tas.	Total
var. <i>capitellata</i>	4	—	—	—	—	—	19	23
var. <i>squamatica</i>	7	—	1	—	35	16	7	66
var. <i>interhiascens</i>	1	—	—	—	3	—	2	6
Total								95

^a including ACT.

DISTRIBUTION

The distributions of the three varieties of *C. capitellata* are summarized in Table 1. Within each State or Territory the taxa appear to be restricted to the cooler, wetter areas; *C. capitellata* sens. lat. occurs only in the south-west of Western Australia, the south-east of South Australia and in the southern and eastern areas of Victoria and New South Wales and throughout Tasmania. Based on an examination of 95 specimens, the most common variety is *squamatica* which occurs throughout the entire range of *C. capitellata*.

sens. lat. var. *capitellata* occurs only in Western Australia and Tasmania and var. *interhiascens*, the least common variety, is restricted to a few localities above 700m in New South Wales and Tasmania, and to one location in Western Australia. A preliminary examination of a limited number of specimens from New Zealand however, showed var. *interhiascens* to be the most common variety, in contrast to the restricted distribution of var. *interhiascens* in Australia.

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